Human Fibroblast IMR90 Hi-C Data (Dixon et al.)

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1 Introduction

The Hi-C technic was first introduced by Lieberman-Aiden et al. [2009]. In the continuity with 3C, 4C and 5C technics, the goal of the Hi-C is to simultaneoulsy detect all chromosomal contacts in a single experiment. All this technics aim at measuring the population-averaged frequency at which two genomic loci physically interact in three-dimensional space. In Hi-C, after a first crosslink and digestion, all genomic fragments are labeled with a biotinylated nucleotide before ligation. These junctions can then be purified efficiently by streptavidin-coated magnetic beads, and finaly sequenced using a standard Illumina paired-end protocol.
The data available in this package were published by Dixon et al. [2012] and downloaded from the GEO website (GSE35156, sample GSM862724). This publication is one of the key paper in the field for two main reasons: i) it was the first time than Hi-C data were generated at such resolution (up to 20kb), ii) this resolution highlighted a new short range structure defined as topological domains (TADs), with high frequencies of intra-domain chromatin interactions but infrequent inter-domain chromatin interactions (Nora et al. [2012]).

If you use *HiCDataHumanIMR90*, please cite:

- Servant N (2014). HiCDataHumanIMR90: Human Fibroblast IMR90 HiC data from Dixon et al. 2012. R package version 1.1.0.
- Dixon JR, Selvaraj S, Yue F, Kim A et al. (2012) Topological domains in mammalian genomes identified by analysis of chromatin interactions. Nature 485(7398):376-80.

2 Hi-C Data

The `hic_imr90_40` object is a *HTClist* object (see the *HiTC* package for more information (Servant et al. [2012])). It contains the complete genome-wide HiC data, with all inter and intrachromosomic contact maps at a resolution of 40kb.

```
> require(HiCDataHumanIMR90)
> require(HiTC)
> data(Dixon2012_IMR90)
```

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```
> ## Show data
> show(hic_imr90_40)

HTClist object of length 325
25 intra / 300 inter-chromosomal maps

> ## Is my data complete (i.e. composed of intra + inter chromosomal maps)
> isComplete(hic_imr90_40)

[1] TRUE

> ## Note that a complete object is not necessarily pairwise
> ## (is both chr1-chr2 and chr2-chr1 stored ?)
> isPairwise(hic_imr90_40)

[1] FALSE

> ## Which chromosomes ?
> seqlevels(hic_imr90_40)

 [1] "chr1"  "chr2"  "chr3"  "chr4"  "chr5"  "chr6"  "chr7"  "chr8"  "chr9"
[10] "chr10" "chr11" "chr12" "chr13" "chr14" "chr15" "chr16" "chr17" "chr18"
[19] "chr19" "chr20" "chr21" "chr22" "chrX"  "chrY"  "chrM"

> ## Details about a given map
> detail(hic_imr90_40$chrXchrX)

HTC object
Focus on genomic region [chrX:1-155270560]
CIS Interaction Map
Matrix of Interaction data: [3882-3882]
Binned data - window size = 40000
3882 genome intervals
Total Reads =  15349610
Number of Interactions =  3362484
Median Frequency =  1
Sparsity =  0.112

> ## Descriptive statistics
> head(summary(hic_imr90_40))

         seq1 seq2  nbreads nbinteraction averagefreq medfreq sparsity
chr1chr1 chr1 chr1 25914788       4524734      5.7274       1   0.8835
chr1chr2 chr1 chr2   504332        497291      1.0142       1   0.9869
chr1chr3 chr1 chr3   440865        434917      1.0137       1   0.9859
chr1chr4 chr1 chr4   456924        450005      1.0154       1   0.9849
chr1chr5 chr1 chr5   399067        393926      1.0131       1    0.986
chr1chr6 chr1 chr6   382580        377654       1.013       1   0.9858
```

3 Topological Domains

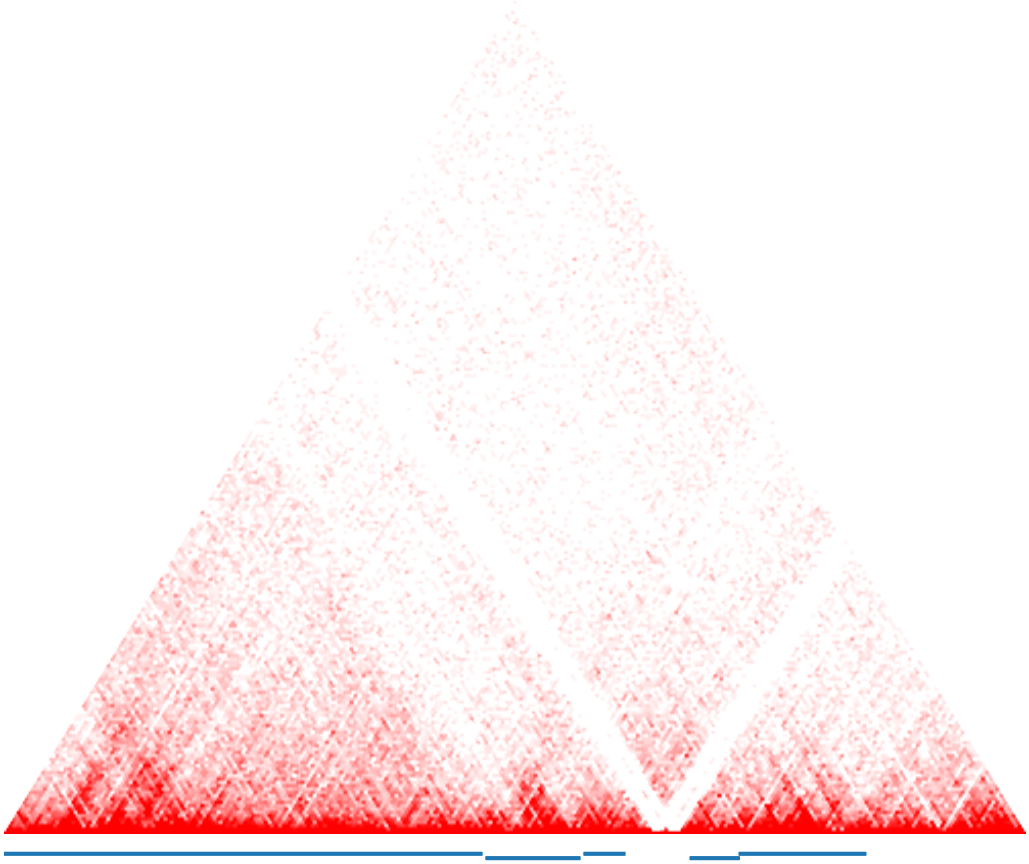
The `tads_imr90` object is a *GRanges* object with a all TADs detected from this Hi-C data.

```
> show(tads_imr90)
```

```
GRanges object with 2338 ranges and 0 metadata columns:
            seqnames              ranges strand
               <Rle>           <IRanges>  <Rle>
     TAD-1     chr1      770138-1290137      *
     TAD-2     chr1     1290138-1850140      *
     TAD-3     chr1     1850141-2330140      *
     TAD-4     chr1     2330141-3610140      *
     TAD-5     chr1     3770141-6077413      *
       ...      ...                 ...    ...
  TAD-2334     chrX 146992309-148552096      *
  TAD-2335     chrX 148592096-149929342      *
  TAD-2336     chrX 149929343-151969344      *
  TAD-2337     chrX 152089345-152746806      *
  TAD-2338     chrX 152786807-154946806      *
  -------
  seqinfo: 23 sequences from an unspecified genome; no seqlengths
```

```
> ## Extract region
> regx <- extractRegion(hic_imr90_40$chrXchrX,
+                       chr="chrX", from=95000000, to=105000000)
> ## Plot Hi-C data with TADs
> plot(regx, tracks=list(tads_imr90), maxrange=20)
```

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Package versions

This vignette was generated using the following package versions:

- R version 4.6.2 (2026-10-29), `x86_64-pc-linux-gnu`
- Running under: `Ubuntu 26.04.1 LTS`
- Matrix products: default
- BLAS: `/usr/lib/x86_64-linux-gnu/openblas-pthread/libblas.so.3`
- LAPACK: `/usr/lib/x86_64-linux-gnu/openblas-pthread/libopenblasp-r0.3.32.so` ; LAPACK version3.12.0
- Base packages: base, datasets, graphics, grDevices, methods, stats, stats4, utils
- Other packages: BiocGenerics 0.59.13, generics 0.1.4, GenomicRanges 1.65.4, HiCDataHumanIMR90 1.35.0, HiTC 1.57.1, IRanges 2.47.5, S4Vectors 0.51.10, Seqinfo 1.3.2
- Loaded via a namespace (and not attached): BiocBaseUtils 1.15.1, BiocIO 1.23.3, BiocManager 1.30.27, BiocParallel 1.47.0, BiocStyle 2.41.0, Biostrings 2.81.9, bitops 1.1-0, buildtools 1.0.0, cigarillo 1.3.1, cli 3.6.6, codetools 0.2-20,

compiler 4.6.2, crayon 1.5.3, curl 8.1.0, digest 0.6.39, evaluate 1.0.5, fastmap 1.2.0, GenomicAlignments 1.49.2, grid 4.6.2, htmltools 0.5.9, httr 1.4.9, knitr 1.52, lattice 0.23-1, maketools 1.3.2, Matrix 1.7-6, MultipleAlignment 0.99.5, parallel 4.6.2, R6 2.6.1, RColorBrewer 1.1-3, RCurl 1.98-1.20, restfulr 0.0.17, rjson 0.2.23, rlang 1.3.0, rmarkdown 2.32, Rsamtools 2.29.0, rtracklayer 1.73.0, sys 3.4.3, tools 4.6.2, xfun 0.62, XML 3.99-0.25, XVector 0.53.0, yaml 2.3.12

References

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